ION MICROPROBE MEASUREMENTS REVEAL LARGE ^{16}O EXCESSES IN AN ORDINARY CHONDRITE CAI.

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The genetic relationships, if any, between rare calcium-aluminum-rich inclusions (CAI) in unequilibrated ordinary chondrites (UOC) and their more common counterparts in carbonaceous chondrites (CC) have important implications for understanding thermal regimes in the solar nebula as well as the original distribution of ^{26}Al in the Solar System. Recently, Russell *et al*. [1] have shown that live ^{26}Al was present in two UOC CAI at a level of $\sim 5 \cdot 10^{-5}$, consistent with that found in most refractory inclusions from CC [2]. This result suggests that ^{26}Al was present at this high initial abundance throughout the regions of the solar nebula where both CC and UOC formed. Alternatively, it is possible that most CAI formed in a more restricted region of the solar nebula, characterized by this high $^{26}Al/^{27}Al$ ratio, and that both chondrite groups tapped this single CAI source, albeit with differing efficiencies. Because oxygen isotope reservoirs were distinct in the nebular accretion regions of the UOC and CC [3,4], the oxygen isotopic compositions of CAI from UOC could provide a means for assessing the provenance of these rare objects.

Presented here are the first oxygen isotopic measurements on a CAI from a UOC. The CAI studied is 1805-2-1 from Semarkona (LL3.0). This fine-grained, irregularly shaped blue hibonite-spinel-melilite inclusion is ~480µm across [1,5,6]. REE abundances show a "Group II" pattern [7], and melilite contains ^{26}Mg excesses at a level indicating $(^{26}Al/^{27}Al)_0 = (4.7 \pm 1.5) \cdot 10^{-5}$ [1].

Oxygen isotopic measurements were performed with the UCLA Cameca ims 1270 ion microprobe using a ~10µm diameter Cs^+ beam and analyzing low-energy secondary ions at high mass resolving power. Because the CAI is so fine-grained and had been extensively sputtered in previous ion probe studies, it was not possible to avoid analyzing mixtures of mineral phases even at the 10µm scale. The oxygen isotope data, corrected for instrumental mass fractionation and detector efficiencies by comparison to a terrestrial spinel standard, are shown in Table 1 along with an estimate of the percentage of the analysis area that consisted of melilite. No attempt was made to correct for matrix effects, which are believed to be < ~1-2‰/amu under these analytical conditions.

Table 1. Oxygen isotopes in Semarkona 1805-2-1

spot	$\delta^{18}O$ (‰)	$\delta^{17}O$ (‰)	$\Delta^{17}O$ (‰)	volume % melilite
1	-41.8 ± 2.4	-45.8 ± 1.8	-24.0 ± 2.1	16
2	-40.0 ± 1.8	-41.9 ± 1.8	-21.1 ± 2.0	18
3	-41.7 ± 1.8	-43.0 ± 1.6	-21.4 ± 1.9	43
4	-42.0 ± 1.8	-45.2 ± 2.0	-23.4 ± 2.2	7
5	-39.7 ± 1.9	-44.1 ± 2.1	-23.5 ± 2.3	55

Semarkona 1805-2-1 is enriched in ^{16}O with $\Delta^{17}O$ values similar to those observed in many CAI from CC; all data points plot within error of the CCAM line. In contrast to CC type B CAI, in which O isotope compositions are strongly correlated with mineralogy [4], 1805-2-1 appears to be isotopically homogeneous at the ~2‰ level, regardless of the mineral phase analyzed. For example, electron microscope analyses of ion probe sputtered pits indicate that spot 4 consisted of >90 vol% spinel and spot 2 ~80% spinel+hibonite, whereas spot 5 was predominantly melilite. This is the first observation of ^{16}O-enriched melilite in a CAI (but see also [8]).

Although the data are obviously limited, the similarity of the O isotopes in a Semarkona CAI to those from CC is consistent with the idea that all CAI may have formed in the same nebula locale. The isotopic homogeneity of 1805-2-1 supports the hypothesis that all CAI minerals were originally ^{16}O-enriched [4]. The O isotopic composition of this Semarkona CAI is markedly different from those of Al-rich chondrules in UOC [9], indicating that there is no clear genetic relationship between the two types of refractory objects in UOC.

References: [1] Russell et al. (1996) Science 273 757. [2] MacPherson et al. (1995) Meteoritics 30, 365. [3] Clayton *et al*. (1991) GCA 55, 2317. [4] Clayton (1993) AREPS, **21**, 115-149. [5] Bischoff and Keil (1984) GCA 48 693. [6] MacPherson et al. (1983) GCA 47 823. [7] Fahey, (1988) Ph. D thesis, pp. 146. [8] Engrand *et al*., this volume. [9] Russell *et al*., this volume.